

CLAIMS

1. A liquid crystal display panel comprising:

5 two substrates (1a, 1b, 3) fixed together by a seal member (2) with their main surfaces opposed to each other;

liquid crystal (6) sealingly stored in a region surrounded by said two substrates (1a, 1b, 3) and said seal member (2); and

a plurality of columnar spacers (5) arranged in the region surrounded by said two substrates (1a, 1b, 3) and said seal member (2), wherein

10 said column spacers (5) are arranged such that a number density of said columnar spacers gradually decreases as the position moves from a center of a display region toward an outer periphery.

2. A liquid crystal display panel comprising:

15 two substrates (1a, 1b, 3) fixed together by a seal member (2) with their main surfaces opposed to each other;

liquid crystal (6) sealingly stored in a region surrounded by said two substrates (1a, 1b, 3) and said seal member (2); and

20 a plurality of columnar spacers (5) arranged in the region surrounded by said two substrates (1a, 1b, 3) and said seal member (2), wherein

a number density of said columnar spacers (5) in a first region (32) near an inner side of said seal member (2) is smaller than that in a second region (31) inside said first region (32).

25 3. A liquid crystal display panel comprising:

two substrates (1a, 1b, 3) fixed together by a seal member (2) with their main surfaces opposed to each other;

liquid crystal (6) sealingly stored in a region surrounded by said two substrates

(1a, 1b, 3) and said seal member (2); and

a plurality of columnar spacers (5) arranged in the region surrounded by said two substrates (1a, 1b, 3) and said seal member (2), wherein

5 a number density of said columnar spacers (5) in a first region (32) except for a display region is smaller than that in a second region (31) outside said first region (32).

4. A liquid crystal display panel comprising:

two substrates (1a, 1b, 3) fixed together by a seal member (2) with their main surfaces opposed to each other;

10 liquid crystal (6) sealingly stored in a region surrounded by said two substrates (1a, 1b, 3) and said seal member (2); and

a plurality of columnar spacers (29, 30) arranged in the region surrounded by said two substrates (1a, 1b, 3) and said seal member (2), wherein

said columnar spacers (29, 30) include:

15 a first columnar spacer (30), and

a second columnar spacer (29) being higher than said first columnar spacer (30) when receiving no load;

said first columnar spacer is arranged in a first region (34) near an inner side of said seal member (2) and a second region (33) located inside said first region (34); and

20 said second columnar spacer (29) is arranged in said second region (33).

5. A method of manufacturing a liquid crystal display panel comprising:

a spacer forming step of forming columnar spacers (5) on one or both of two substrates (1a, 1b, 3) to be adhered together, said spacer forming step being configured
25 to form said columnar spacers (5) such that a number density of said columnar spacers decreases as the position moves from a center of a display region to be formed toward an outer periphery.

6. The method of manufacturing the liquid crystal display panel according to claim 5, further comprising:

a liquid crystal drop applying step of applying a drop of liquid crystal (6) to one or both of said two substrates (1a, 1b, 3), wherein

5 said liquid crystal drop applying step applies a smaller quantity of liquid crystal (6) than a calculated value obtained when said two substrates (1a, 1b, 3) are parallel spaced from each other by a distance of a designed value.

7. A method of manufacturing a liquid crystal display panel comprising:

10 a spacer forming step of forming columnar spacers (5) on one or both of two substrates (1a, 1b, 3) to be adhered together; and

a seal member arranging step of arranging a seal member (2) on a main surface(s) of one or both of the substrates (1a, 1b, 3) to be adhered together, wherein

15 said spacer forming step is configured to form said columnar spacers (5) such that a number density of said columnar spacers (5) in a first region (32) near an inner side of said seal member (2) is smaller than that in a second region (31) inside said first region.

8. The method of manufacturing the liquid crystal display panel according to claim 20 7, further comprising:

a liquid crystal drop applying step of applying a drop of liquid crystal (6) to one or both of said two substrates (1a, 1b, 3), wherein

25 said liquid crystal drop applying step applies a smaller quantity of liquid crystal (6) than a calculated value obtained when said two substrates (1a, 1b, 3) are parallel spaced from each other by a distance of a designed value.

9. A method of manufacturing a liquid crystal display panel comprising:

a spacer forming step of forming columnar spacers (5) on one or both of two

substrates (1a, 1b, 3) to be adhered together; and

a seal member arranging step of arranging a seal member (2) on a main surface(s) of one or both of the substrates (1a, 1b, 3) to be adhered together, wherein

5 said spacer forming step is configured to form said columnar spacers (5) such that a number density of said columnar spacers (5) in a first region (32) avoiding a display region to be formed is smaller than that in a second region (31) outside said first region.

10 10. The method of manufacturing the liquid crystal display panel according to claim 9, further comprising:

a liquid crystal drop applying step of applying a drop of liquid crystal (6) to one or both of said two substrates (1a, 1b, 3), wherein

15 said liquid crystal drop applying step applies a smaller quantity of liquid crystal (6) than a calculated value obtained when said two substrates (1a, 1b, 3) are parallel spaced from each other by a distance of a designed value.

11. A method of manufacturing a liquid crystal display panel comprising:

a spacer forming step of forming columnar spacers (5) on one or both of two substrates (1a, 1b, 3) to be adhered together; and

20 a seal member arranging step of arranging a seal member (2) on a main surface(s) of one or both of the substrates (1a, 1b, 3) to be adhered together, wherein

25 said spacer forming step is configured to form a first columnar spacer (30) in a first region (34) near an inner side of said seal member (2), and to form the first columnar spacer (30) and a second columnar spacer (29) higher than said first columnar spacer (30) in a second region (33) inside said first region (34).

12. A substrate with a spacer comprising a substrate (101); and a spacer formed on said substrate (101), wherein

said spacer (105) has at least a first spacer portion (105a), and a second spacer portion (105b) formed above said first spacer portion (105a), and an upper portion of said first spacer portion (105a) has a larger diameter than a bottom of said second spacer portion (105b).

5

13. The substrate with the spacer according to claim 12, wherein
the upper portion of said first spacer portion (105a) has a groove (105c)
surrounding said second spacer portion (105b) in a plan view.

10

14. The substrate with the spacer according to claim 12, wherein
assuming that an upper portion of said spacer (105) has a diameter of C, and said
spacer (105) has a height of H from the bottom to the upper portion, said spacer (105)
has a diameter of $(1.8 \times C)$ or more at the bottom, and has a diameter of $(1.05 \times C)$ or
less at a height of $(0.85 \times H)$ from the bottom of said spacer (105).

15

15. A panel having the substrate with the spacer according to claim 12; an opposed
substrate (102) opposed to said substrate (101) with the spacer, and a function material
layer interposed between said substrate (101) with the spacer and said opposed substrate
(102).

20

16. The panel according to claim 15, wherein
said function material layer is a liquid crystal layer (104).

25

17. A method of manufacturing a panel according to claim 16, comprising the steps
of:

forming a frame-like seal member (103) on a substrate surface of one of said
substrate (101) with the spacer and said opposed substrate (102);
applying a liquid crystal material to an inside of a frame of said seal member

(103); and

adhering said substrate (101) with the spacer and said opposed substrate (102) together to form said liquid crystal layer (104).